

LIX.—*Revision of British Mollusca.* By the Rev. Canon
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MORE than twenty years have passed since my old friend Dr. Gwyn Jeffreys's work—'British Conchology'—was completed. In the decade which preceded that time we had in company dredged extensively round the British Islands, and especially in the sea east, west, and north of Shetland, down to 170 fathoms, which was the greatest depth at which, up to that time, the sea on our coast had been explored. The new species discovered in these expeditions mainly constituted the additions to our fauna for the first time to be found in the work referred to.

In 1868 private dredgings began to be greatly surpassed in importance by expeditions undertaken at the expense of our government. The President and Council of the Royal Society were successful in a request made to the Lords of the Admiralty. A scheme for deep-sea dredging was sanctioned, and the surveying-ship 'Lightning' commissioned for the work. In this steamer Drs. Carpenter and Wyville-Thomson explored the sea between Scotland and the Faroe Islands in depths down to 650 fathoms.

The results were most encouraging, and in the following year (1869) the 'Poreupine' was despatched for more extended operations to the south and west of Ireland and north of Scotland. The work of this year was a complete success, and discoveries were made, both physical and biological, of the highest value. Dredgings were carried down to 2435 fathoms. Drs. Carpenter, Jeffreys, and Wyville-Thomson were the scientific men in charge during these cruises.

The next important work which threw light upon the British marine fauna was that done by H.M.'s hired ship 'Knight Errant,' under the direction of Dr. John Murray, in the neighbourhood of the "Wyville-Thomson Ridge" in 1880.

In 1882 the government ordered the 'Triton,' a composite steamship of 410 tons, to resurvey and more thoroughly explore the remarkable geographical features connected with the sea-bottom on either side of the "Wyville-Thomson Ridge." Dr. John Murray had again the scientific direction in this expedition.

Last year (1889) a short dredging trip in deep water off the south of Ireland by H.M.S. 'Research' was superintended by Mr. G. C. Bourne, the Director of the Marine Biological

Association of the United Kingdom ; and there was also some good trawling off the south-west of Ireland, conducted during a week's cruise in a hired steamer, the 'Flying Fox,' by the Rev. W. Spotswood Green, the deepest trawl being in 1000 fathoms.

In all these expeditions Mollusca have been found either hitherto undescribed or not before known to exist in the sea around the British Islands.

Dr. Gwyn Jeffreys was at the time of his death engaged in publishing a series of papers in the 'Proceedings of the Zoological Society' on the Mollusca obtained in the more important of these expeditions. He died before these papers were finished, and we therefore still remain in ignorance of what was found among many families of the Gastropoda. It is to be hoped, however, that Mr. E. A. Smith will before long complete the work with the help of MS. left by Jeffreys and such specimens as are in the British Museum.

Reference is, however, made in various papers published by Dr. Jeffreys to species of those families which were procured in the 'Porcupine' expedition. My friend, had his life been prolonged, would have drawn up a fresh list of the Mollusca which inhabit the British area. In attempting to do this now I shall have to mainly rely in the earlier part of this revision upon notes scattered through Dr. Jeffreys's various papers, while for the rest his account of "The Mollusca procured during the 'Lightning' and 'Porcupine' Expeditions" will supply the chief material as regards the deep-sea fauna.

It may be stated with respect to my purpose and revision generally—

1. That there were many cases of nomenclature adopted in 'British Conchology' with which I felt unable to agree at the time of its publication and am equally unable to acquiesce in now.

2. Many works have since been published, and the light which has been thrown from many sides on groups of Mollusca necessitates numerous alterations in nomenclature and arrangement.

3. Many recent malacological investigators of the Pteropoda (Boas, Pelseneer, Grobben, &c.) are agreed that these Mollusca should not be maintained as a distinct Class, but rather as an order or as families of the Gastropoda. That view is here followed.

4. Jeffreys not having studied the Nudibranchiate Mollusca requested Mr. Alder to draw up the account of that order. As Mr. Alder did not give the geographical distribution of the species, I have supplied this as far as I am able.

5. The distribution of the testaceous species has been very fully worked out by Jeffreys in 'British Conchology' and his subsequent papers. Distribution is for the most part only given here for the additions to the British list; nor have I thought it necessary to add further localities for well-known British species, except in the case of those which are most rare.

6. While the general arrangement of Fischer's 'Manuel de Conchyliologie' has in the main been adopted, it has in many points been departed from. Perhaps the chief of these is that Fischer has not been followed in dividing the Pelecypoda into the orders Tetrabranchiata and Dibranchiata, since such an arrangement in many cases widely divorces genera which seem in most points to be nearly related. I have here adopted the more recently expressed views of Dr. Dall.

7. Certain groups, such as the Pleurotomidæ, the Rissoidæ, and the Gymnoglossa, present unusual difficulties in arrangement by their shells, difficulties which can only be removed when we have become much more fully acquainted with the animals which form them. I have done the best I can with these groups, but am far from satisfied with the results. My endeavour has been to steer a middle course between those conchologists who excessively multiply genera and the arrangement of Jeffreys, who, in my opinion, made his genera too large—a course which he, subsequently to the publication of 'British Conchology,' most markedly departed from.

The British Area.

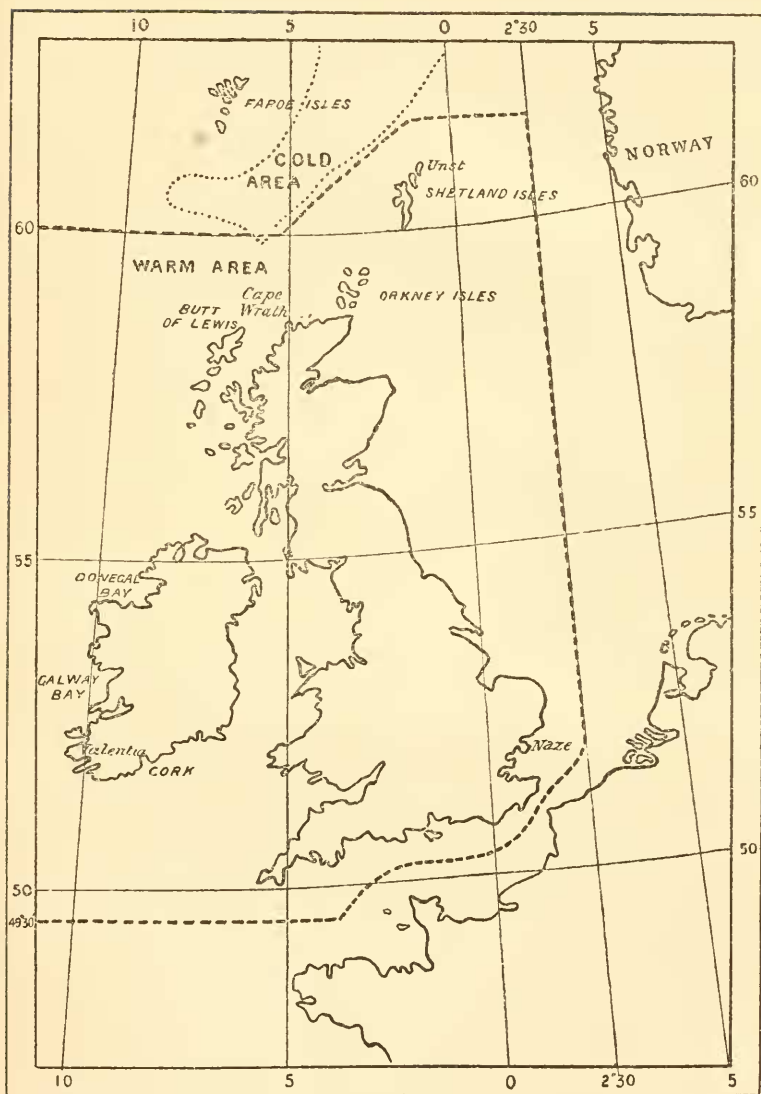
The area regarded as British is that which I have indicated in a paper on the subject printed in last month's number of this Journal ('Annals,' May 1890), where it is thus defined:—

South.—By lat. $49^{\circ} 30'$ N., which parallel passing eastwards terminates at long. $5^{\circ} 0'$ W., or midway between the Land's End and Brest. Thence mid-Channel is followed until lat. $51^{\circ} 50'$ N. is reached off the east coast.

East.—From lat. $51^{\circ} 50'$ N., long. $2^{\circ} 30'$ E. is taken as the eastern boundary northwards.

North.—Lat. $60^{\circ} 0'$ N., coming from the west as far as long. $5^{\circ} 0'$ W., thence due north-east to long. $1^{\circ} 0'$ W., thence due east to meet the eastern boundary at $2^{\circ} 30'$ E.

West.—Down to the base of the continent at 1500 fathoms.



The British Marine Area, showing its Southern, Eastern, and Northern Limits.

[The finely dotted line to the north indicates the boundaries of the "cold area" or "Faroe Channel."]

The following dredgings of the British Government expeditions were beyond the British area:—

1. '*Lightning*,' 1868.—Stats. 2 to 11, 15, 16, which were all too far north. The only stations therefore of this expedition which were within our area were 1, 12, 13, 14, 17.

2. '*Porcupine*,' 1869.—St. 11, in too deep water, 1630 fathoms; Stats. 33 to 42 too far south; Stats. 51, 52, 53, 54 to 64, 76, 77, 83, too far north. Three other dredgings should in my opinion, and in accordance with the views expressed in last month's '*Annals*,' be excluded. Stat. 54, lat. $59^{\circ} 46'$ N., long. $6^{\circ} 27'$ W., 490 fath., temp. $31^{\circ} 4$ Fahr., and Stat. 86, lat. $59^{\circ} 48'$ N., long. $6^{\circ} 31'$ W., 445 fath., temp. $30^{\circ} 1$ Fahr., are slightly to the south of the northern boundary, but at that particular spot the Faroe Deep crosses lat. 60° , and the Faroe Ridge is to the south of it; consequently it is thus part of the "cold area" with the water below freezing-point*, and this little southern projection of the cold area should be rejected. Again, Stat. 65, lat. $61^{\circ} 10'$ N., long. $2^{\circ} 21'$ W., 345 fath., temp. 30° Fahr., is exactly on the boundary line which runs north-east, and the temperature being below freezing-point, this dredging I also exclude.

'*Porcupine*,' 1870.—No dredgings of this year were within our area.

3. '*Knight Errant*,' 1880.—Stats. 1, 2, 8 were too far north.

4. '*Triton*,' 1882.—Stats. 3 to 9 and 12 were too far north. The only dredgings in this expedition south of lat. 60° N. were 1, 2, 10, 11, and 13.

Great caution must be used in reading Jeffreys's notes of species in his scattered records. He often uses such loose expressions as "north of the Butt of Lewis" or "to the north of Scotland," when the shell was really found north of lat. 60° N. and in the "cold area" of the Faroe Channel.

The following is a list of papers by Dr. Jeffreys in which allusion is more or less made to Mollusca procured in the '*Porcupine*' and other expeditions:—

1870. CARPENTER, JEFFREYS, and WYVILLE-THOMSON. "Preliminary Report of the Scientific Exploration of the Deep Sea in H.M.S. '*Porcupine*.'" Proc. Roy. Soc. vol. xviii, p. 397.

1870. CARPENTER and JEFFREYS. "Report Deep-Sea Researches, July–Sept. 1870, by H.M.S. '*Porcupine*.'" Proc. Roy. Soc. 1870, vol. xix, p. 146.

* See my paper on "The British Marine Area" in '*Annals*' for May 1890.

1870. JEFFREYS. "Norwegian Mollusca." Ann. & Mag. Nat. Hist. ser. 4, vol. v. p. 438.
1870. ———. "Mediterranean Mollusca." *Ibid.* vol. vi. pp. 65, 457.
1872. ———. "Mollusca of Europe compared with those of Eastern North America." *Ibid.* vol. x. p. 237.
1873. ———. Mollusca in Wyville-Thomson's 'Depths of the Sea.'
1874. ———. "Some Remarks on the Mollusca of the Mediterranean." Report Brit. Assoc. for 1873, p. 111.
1876. ———. "Preliminary Report Biological Results of Cruise of H.M.S. 'Valorous' to Davis Strait." Proc. Roy. Soc. p. 177.
1877. ———. "Post-Tertiary Fossils and some recent Mollusca of Arctic Expedition." Ann. & Mag. Nat. Hist. ser. 4, vol. xx. p. 229.
1877. ———. Address Biological Section British Association. Report Brit. Assoc. 1877.
- 1876-77. ———. Papers on the "Mollusca of the 'Valorous' Expedition." Ann. & Mag. Nat. Hist. ser. 4, vols. xviii. and xix.
- 1878-85. ———. "Mollusca procured during the 'Lightning' and 'Porcupine' Expeditions." Proc. Zool. Soc. 1878-85.
1880. ———. "Deep-sea Mollusca of the Bay of Biscay." Ann. & Mag. Nat. Hist. ser. 5, vol. vi. (Two papers.)
1882. ———. "Mollusca of Italian Exploration of the Mediterranean." *Ibid.* vol. viii. p. 389.
1883. ———. "Mediterranean Mollusca." *Ibid.* vol. xi. p. 393.
1882. ———. Mollusca in Murray's (John) "Exploration of Faroe Channel, 1880, in 'Knight Errant.'" Proc. Roy. Soc. Edinb. vol. xi.
1883. ———. "Mollusca procured during Cruise of H.M.S. 'Triton' between the Hebrides and Faroes." Proc. Zool. Soc. 1883, p. 389.
1884. ———. "Concordance of Mollusca inhabiting both sides of the Atlantic." Report Brit. Assoc. 1884.

MOLLUSCA.

Class I. CEPHALOPODA.

The Cephalopoda are divided into two orders, those which have eight arms surrounding the mouth, and are therefore termed Octopoda, and those which, in addition to these eight arms, have two more of different structure, in which clubs

furnished with suckers surmount long stalks ; these are the Decapoda (or Decacera).

D'Orbigny arranged the Decapoda in two groups—

OIGOPSIDES, in which the eyes have the crystalline lens unprotected by any special membrane, so that they are in immediate contact with the water.

MYOPSIDES, in which the crystalline lens is protected from immediate contact with the water, being covered by a transparent membrane continuous with the orbital cartilages. An eyelid below the eye.

Gray and Fisher arranged this order by means of the differences of the shell—

Chondrophora.—Shell corneous, thin, gladius-shaped or lanceolate, a “pen.”

Sepiophora.—Shell calcareous, spongy, laminar, a “cuttle-bone.”

Phragmophora.—Shell calcareous, consisting of a number of air-chambers connected by a siphonal tube.

D'Orbigny's arrangement from the first was never received with much favour. But when, in the early investigations on hectocotylization, or the sexual modification of one of the arms in the male Cephalopod, this hectocotylization had been observed by Steenstrup in the various families of Myopsides, but not at all in the Oigopsides, he was led in his admirable paper on the subject* to regard that absence as proof of the wisdom of d'Orbigny's classification, and wrote “This summary” (of hectocotylization in the various genera) “furnishes a very striking evidence that there must be something natural in d'Orbigny's division of the Decapod Cephalopoda into the two principal groups ‘Myopsides’ and ‘Oigopsides,’ although no great inclination to adopt them has hitherto been shown. The difference in the conditions of reproduction shows especially that the genus *Ommatostrephes*, d'Orb., is still more entitled to be removed far from the genus *Loligo*, with which even modern malacologists, such as Verany and Troschel, persist in placing it.” But all this is changed. The male of *Ommatostrephes* and its allies are described, and the males of other species of the Oigopsides are known. As far as thus known they closely conform in the hectocotylization of one of the ventral arms to this character in the genus *Loligo*. Moreover, it would now seem that the Oigopsid eye is not confined to the group Oigopsides, for Verrill has described a genus *Stoloteuthis* † which, though it is said in general characters to be closely allied to *Sepiola*, has this peculiar feature. He writes:—

* See translation, Ann. & Mag. Nat. Hist. ser. 2, vol. xx. (1857), p. 81.

† Verrill, Trans. Connect. Acad. Sci. v. (1881), p. 417.

"This species is the type of a very distinct genus, especially remarkable for being the only known genus among Myopsidæ that has round pupils and the eyelids free all around. In fact it shows quite conclusively that this division of the Decapoda into two groups, based on the presence or absence of free eyelids, is purely artificial and of little or no systematic value." The conclusion I arrive at is that the division of the Decapoda into two primary groups by the character of the eye should be regarded as of secondary importance. Thus viewed the Oigopsida are a specialized and very natural group which should be kept together near to *Loligo*, while other considerations come in which appear to point to the desirability of breaking up the group Myopsides, though Steenstrup still maintains the Myopsides and Oigopsides as primary divisions.

The arrangement by their shells was first put forward by J. E. Gray*. He divided the Decapoda—or Sephenia as he called them—into three suborders, I. Chondrophora, II. Sepiophora, III. Belemnophora. Dr. Paul Fischer† has, in his recently published work, followed this arrangement, only substituting the preferable term Phragmophora for that of Belemnophora. This appears as a whole a very natural arrangement, and in it we seem to find the best guide to the archaic history of the class. The Phragmophora have the shell divided into air-chambers, as, for example, in the recent genus *Spirula*, in which "the multilocular shell corresponds with the phragmocone of the Belemnite" (*Owen*); and this recent genus is at once distinguished from the Sepiophora not only by the character of the shell, but by the absence or very rudimentary condition of the fins. Next come the Sepiophora, in which the septa are exchanged for a series of continuous calcareous deposits, forming an internal shell of considerable size, but of such a spongy character as still to be capable of retaining air; while the animal, which bears the sepia shell, differs from the Phragmophora and Chondrophora in its wide depressed form and in its fins, which usually fringe the whole length of the body. It agrees with both in having one of the lower or ventral arms in the male sexually affected; but here the hectocotylization is usually at the base, in the others at the extremity of, or rarely throughout, the arm. Next we come to the Chondrophora, where we find that "the primitive shell-gland and shell-sac have become fused"

* Brit. Mus. Cat., Cat. Mollusca in Coll. of B. M. pt. 1, Cephalopoda antepedia (1849).

† 'Manuel de Conchyliologie et de Paléontologie conchyliologique' (1887).

(*Ilyatt*), and the shell itself is reduced in importance, narrow, lanceolate or spathulate, and its structure corneous, or sometimes altogether absent; and from these we pass to the Octopoda, where, as one of many wide differences of structure, the shell is rudimentary or wholly absent*.

It must not be supposed that I have been intimating in the preceding paragraph that the several groups of Decapoda have been derived from each other. That, I take it, certainly is not the case. They appear all to be derivatives in different directions from the ancient *Belemnites*.

No linear arrangement can ever adequately and fully demonstrate the varied alliances of groups. Such groups have diverged in many directions from earlier types, and while differing more and more widely in the especial characters in which their divergence is evidenced, will nevertheless be, so to speak, *laterally* bound together by the retention of many points in common during a shorter or longer period in their onward course of successive modifications. Again, the law of recurrence must be supposed to be not unlikely to come in. Organs which have been modified or to a greater or less extent suppressed under certain conditions of life and environment, when those conditions are partially or wholly reversed may be expected to revert more or less to their original condition rather than that they should undergo change in a new direction, although such new direction might equally subserve the same purpose. Again, the very same modifications which have taken place in a line of divergence which we will call A, may supervene at a much later period in another line of divergence B; for B had at an earlier time been undergoing modification in other parts of its structure than those at that same period followed by A, but when ultimately somewhat similar modifications having taken place in the same organ, which had long before diverged from the original type in A, the distant descendants of B may in this respect appear to us actually more nearly related to A than were its progenitors.

The Oigopsida preserve in their hooked acetabula (or suckers), in the indications of a phragmocone at the extremity of the internal shell (*Ommatostrephes*), and general form of body more of the characters of the ancient *Belemnites* than any other existing group. In *Belemnoteuthis antiqua*, Pearce, of the Oxford Clay, we seem to recognize a form which may represent a connecting-link; the arms are furnished with

* The beautiful egg-case of the genus *Argonauta* is not a true shell. It does not take its origin in a shell-gland, but is a secondary product of the dorsal arms, which are greatly expanded and turned back over the mantle.

hooked acetabula, the shell has its phragmocone largely developed, while the mucro, which is so conspicuous in typical *Belemnites*, is here almost evanescent. In the Solenhofen beds of Bavaria, which are supposed to be of nearly similar horizon to the Kimmeridge Clay, the genus *Acanthoteuthis* appears to be a decided Chondrophore, with hooked acetabula, and in *Conoteuthis Dupinianus*, d'Orb., from the Gault, we find a shell which shows approach to that of *Ommastrephes*, though the arms are unfortunately unknown.

Belemnites first appears, I believe, in the Jurassic formations. In the Lower Lias it is abundant, and with it is the genus *Geoteuthis*, which is perhaps a Chondrophore. In the Upper Lias occurs *Teuthopsis*, which is certainly a Chondrophore, but the specimens in the British Museum show no appendages to prove whether it is more likely to have been an Oigopsid or Myopsid; but forms ascribed to the same genus in the Oxford Clay have rather short and broad arms, which show no sign of hooked acetabula, and must belong to an animal allied either to the Ommastrephidæ or the Loliginidæ.

The Sepiophora first appear in the Kimmeridge Clay in *Coccoteuthis latipennis*, Owen, but the bone only is known; and there is in the British Museum an unnamed species from the Solenhofen deposits of Bavaria, the bone of which shows a very near approach to the form of the cuttle-bone in existing species of *Sepia*.

The origin of the Spirulidæ is most obscure. They are possibly derivatives from one of the more simple forms of Ammonite or from such a genus as *Spirulirostra*.

Classification by the shell is very valuable for that purpose with respect to fossil forms, since it is always preserved if any part of the animal is fossilized; while, on the other hand, the eyes are useless in the investigation of fossil forms, as their structure is rarely (if it is ever) recognizable. But while fully weighing this fact, and holding such classification to be a much truer division according to our present knowledge than that of d'Orbigny, it appears to me that our insight into the hectocotylyzation in this class has now attained sufficient importance to justify us in employing it as an important factor in classification. Steenstrup, in the paper to which I have already referred, insisted on its value. He wrote:—"The justification of the mode here adopted of employing the hectocotylyzed arm as a rule for the natural collocation of the forms lies in its importance for the entire reproduction. It would be inconceivable that the various occurrence of this metamorphosis, sometimes in one sometimes in the other pair of arms, sometimes on the right and sometimes on the left side, some-

times at the apex and sometimes at the base of the arm, &c., should not give rise to the same number of differences in the mode of fecundation, and in the positions and manner in which the seminal mass is placed upon the female, inasmuch as it appears that the semen is hardly involuntarily or mechanically emitted or poured out upon the eggs, but that this is effected by conscious movements. What is furnished us in this respect by simple reflection is also confirmed by observation. The seminal mass is actually attached to very different parts and under very different conditions." Professor Steenstrup, at the time he wrote that passage, was unacquainted with any instances of hectocotylization among the Oigopsides, and therefore thought that the discovery of hectocotylization had given strength to d'Orbigny's divisions; but, as has been already pointed out, hectocotylization breaks down that classification.

The following arrangement is suggested as one based primarily upon the sexual distinctions. At the same time it will not dismember d'Orbigny's natural group of Oigopsides, which will, however, take a subordinate place, nor will it in any way interfere with the arrangement by means of the shell, but, indeed, proceed nearly *pari passu* with it. It breaks up the Myopsides.

Subclass **DIBRANCHIATA.**

Order I. OCTOPODA.

MESARSENIA *.

Hectocotylization takes place in the third arm of the male, while some of the suckers of the other arms are in that sex much larger than in the female in certain genera; in others the tips of the arms under modification.

Order II. DECAPODA.

A. CHONDROPHORA.

Suborder I. OPISTHARSENIA †.

One of the first or dorsal arms generally hectocotylized. Middle arms having some of the suckers in the male much larger than in the female.

* μέσος, middle, ἄρσεν, male.

† ὀπισθίος, at the back, ἄρσεν, male.

The Opistharsenia show many approaches to the Octopoda. 1st, the lateral arms of the male have enlarged suckers; 2nd, the body is short and ovate; 3rd, the fins almost invariably hold quite a different position from that assumed by them in the following suborders, being situated in the middle of the sides as in some Octopods; 4th, the shell is usually thin, corneous, narrow, and not more than half the length of the body, but is wholly absent in certain genera*.

The tentacular arms are retractile into cavities. The spermatophores are deposited at the orifice of the oviduct of the female. The formula of the radula is 2—1.1.1—2. Eggs isolated, though deposited in many gelatinous masses, each mass containing a large number of eggs.

Fam. Sepiolidæ.

Suborder II. PROSTHARSENIA †.

Hectocotylization of one of the fourth, *i. e.* ventral arms.

Section 1. ANOPROSTHARSENIA ‡.

In this section the terminal portion of the arm is that affected by hectocotylization, more rarely the entire arm undergoes modification (genus *Loliolus*). Body much produced, more or less cylindrical; fins at more or less of the hinder portion of the sides of the body and reaching its termination, or, if the body stretches beyond them, it is only as a pointed extremity. Shell internal, horny, thin, gladius-formed, or lanceolate.

Tribe 1. OIGOPSIDA.

Eyes with a wide opening, through which the crystalline lens may project and be in immediate contact with the water. Spermatophores (in *Ommastrephidæ*) deposited in the branchial cavity of the female near the root of the gills. Formula of the radula usually 1—2—1.1.1—2—1. The middle and first laterals tricuspid, the outermost a very small quadrangular plate (but in the genus *Gonatus* there are only five teeth).

* *Stautoteuthis* and *Iniotheuthis*, Verrill.

† *πρόσθιος*, in front, *ἄσπρη*, male, in reference to the male having the fourth or front arm hectocotylized.

‡ *ἄνω*, from above, having the distal portion of the arm sexually affected.

Fam. Cranchiidæ.

Fam. Chiroteuthidæ.

Fam. Ommastrephidæ.

Tribe 2. *MROPSIDA* (restricted).

Eyes with a fibrose capsule attached to and continuous with the orbital cartilage, and transparent over the crystalline lens, which it covers. Spermatophores deposited under the buccal membrane of the female, which is especially modified for the purpose. Eggs in very numerous mucilaginous elongated masses, each containing very numerous eggs, and the whole attached together at one extremity. Formula of the radula and character of teeth exactly as in the Oigopsida of the genus *Ommatostrephes*.

Fam. Loliginidæ.

B. SEPIOPHORA.

Section 2. KATOPROSTHARSENIA*.

Hectocotylyzation on the basal portion of the fourth or ventral arm of the male †.

Body wide, depressed; fins extending like a frill nearly the whole length of the body; shell calcareous, laminated, spongy, a cuttle-bone. Spermatophores attached under the buccal membrane of the female. Eggs ovoid, mamillated distally, and produced at the base into a stalk, by which they are attached to weeds. Formula of the radula 1—2. 1. 2—1, the central and two inner laterals are alike, triangular and simple, the outermost laterals are falciform.

Fam. Sepiidæ.

Mantle supported by a cartilaginous, semilunar or conical button, and a corresponding pit.

C. PHRAGMOPHORA.

Shell (in *Spirula*) in the form of a number of air-chambers connected with each other by means of a siphon. Hectocotylyzation in both of the fourth or ventral arms.

* *κάτω*, below, having the basal portion of the front arm hectocotylyzed.

† *Sepia andreanoides*, Hoyle ('Challenger' Report), is exceptional in having the arm sexually affected to its extremity.

Fam. **Spirulidæ.**

Three genera which Steenstrup regards as allied to *Spirula*, *Sepiadarium*, *Sepioloidea*, and *Idiosepius*, Steenstrup, have no shell. Fischer places these genera in two families near the Loliginidæ. The hectocotylyzation of *Idiosepius* very closely accords with that of the male *Spirula australis* described by Owen; both ventral arms are entirely or almost entirely devoid of suckers, and one is of much larger size than the other. Steenstrup places the two groups *Sepiadarium* and *Idiosepius* in his family Sepio-Loliginei, and thus defines them:—

Group *Sepiadarium*. Fins narrow, occupying only smaller portion of the length. No internal shell. Mantle united to neck on the back. One of the fourth or ventral arms hectocotylyzed. Genera *Sepiadarium* and *Sepioloidea*.

Group *Idiosepius*. Fins small, terminal. Mantle supported by cartilaginous prominence or ridge and corresponding pit or furrow. Both ventral arms hectocotylyzed. Genera *Idiosepius*, which has no internal shell, and *Spirula*.

Being unacquainted with the foregoing interesting genera, I abstain from any conjecture as to their alliances.

Class I. **CEPHALOPODA.**

Subclass **DIBRANCHIATA.**

A. **MESARSENIA.**

Order I. **OCTOPODA.**

Fam. 1. **Octopidæ.**

Genus 1. **OCTOPUS**, Lamarek.

Sars thus describes the radula in this genus:—"Lamellæ radulæ medianæ magnæ, acie in cuspidem recurvam longe protractam exserta; laterales utrinque 2 valde inæquales, interior minima et rudimentaris, exterior magna, basi quadrangulæ, acie unicuspidata; uncini utrinque singuli, falci-formes, incurvi; laminæ limbi magnæ, quadrangulæ. Formula radulæ 1—1—(1.1).1.(1.1)—1—1.

1. *Octopus vulgaris*, Lamarek.

The males of *Octopus vulgaris* have one or more of the suckers (including generally the 14th to the 16th) of their lateral arms of disproportionately large size; at the same time the third right arm is much shorter than the left, distinctly thinner in its outer half, and the fold of skin, which is very white on the surface turned inwards, gives the arm an appearance as if the side of the arm were divided into two parts by a longitudinal cleft.

Guernsey and Herm (*A. M. N.*), Plymouth (*Biolog. Lab.*), Weymouth (*Hoyle, in litt.*), Liverpool (*Collingwood*), Lamlash Bay, Firth of Clyde (*Wyville Thomson*), Firth of Forth (*Grant and Neill*). It is desirable that these more northern habitats should be confirmed. Though stated to be "not uncommon" in the Firth of Forth, all Mr. Hoyle's endeavours to procure it from that locality have failed, and possibly *Eledone cirrosa* may have been mistaken for it.

2. *Octopus arcticus*, Prosch.

? *Sepia groenlandica*, Dewhurst, Nat. Hist. Cetacea, 1834, p. 263.

Octopus arcticus, Prosch, K. Dansk. Vidensk. Selsk. Skrif. ser. 5, i. (1849), p. 53, figs. 1-3.

Octopus arcticus, Steenstrup, Ann. & Mag. Nat. Hist. ser. 2, xx. (1857), p. 97, pl. iii. fig. 2.

Octopus Bairdii, Verrill, Amer. Journ. Sci. 1873, v. p. 5; Trans. Connect. Acad. Sci. v. (1881), p. 368, pl. xxxiii. figs. 1, 1 a, pl. xxxiv. figs. 5, 6, pl. xxxvi. fig. 10, pl. xxxvii. fig. 8, pl. xlix. figs. 4, 4 a, pl. li. figs. 1, 1 a.

Octopus Bairdii, G. O. Sars, Moll. Reg. Arct. Norv. p. 339, pl. xxxiii. figs. 1-10, and dentition, pl. xvii. fig. 8.

Octopus arcticus, Hoyle, Report 'Challenger' Cephalop. p. 91.

Body short and thick, broadly rounded posteriorly, separated from head by only slight constriction at the sides. Lateral fold of the skin more or less distinct; lower portion of the body below the fold smooth; upper surface of body more or less studded, sometimes even to the arms, with roughish warts or tubercles of various size; often the largest of these is a supraorbital cirrus, which occasionally (and especially in the males) attains a considerable length, and is acutely conical and itself studded with lesser tubercles. Arms rather short, a connecting-web unites them for about one third of their length; they taper to very fine points; suckers small, little raised, those in each row separated from each other by a wide space often equalling their own diameter. Colour above dusky violet, below somewhat paler. In the male the right arm of the third pair is remarkably modified; it has its extremity greatly enlarged into a broadly elliptical spoon-like

organ, of which the inner concave side is transversely divided by a number (thirteen in my specimen) of ribs which slightly incline forwards; anterior to these there is at the base a V-shaped fold, the point of the fold being directed forwards.

The largest Irish specimen has a total dorsal length from the extremity of the body to the end of a dorsal arm of 161 millim.; of this the body and head occupy 47 millim., the membrane connecting the arms 40 millim., and the free portion of the arm 74 millim.; breadth of body 45 millim. The animal was preserved in strong spirit.

"Lamellæ radulæ medianæ basi semielliptica, margine antico leviter emarginato, postice convexo, acie acuminata, marginibus lævibus, non denticulatis. Segmenta radulæ 64." (*G. O. Sars.*)

Mr. G. C. Bourne trawled two fine females of this species last year in H.M.S. 'Research' off the south of Ireland. The smaller specimen is not so tuberculate as the larger, and neither of them shows the more elevated supraorbital process, though that portion of the animal is more covered with prominent tubercles than the rest of the body. In this respect it accords with an American male for which I am indebted to the United States National Museum. Mr. Hoyle has also examined the specimens, and agrees with me that they belong to this species. I have also to thank that friend for information on several points on which I have consulted him in reference to the Cephalopoda.

Distribution. *Octopus arcticus* occurs off the whole north-east American coast from Newfoundland and Nova Scotia to South Carolina in 45-524 fathoms. G. O. Sars has found it off West Norway, Lofoten, and East Finmark in 80-300 fathoms. In the 'Porcupine' expedition it was twice met with in the Faroe Channel in 345-632 fathoms, and in the same Channel it was procured by the 'Knight Errant' in 540 fathoms, and by the 'Triton' in 608 fathoms; and if it be *Sepia grænlandica*, Dewhurst, it also lives in the Greenland Sea.

Fam. 2. Eledonidæ.

Genus 2. ELEDONE, Leach.

Radula having the central tooth very large and acute. With two teeth on each margin towards the base; two laterals on each side, the inner small and rudimentary, the outer unicuspidate and large (but much smaller than the great central tooth); a single falcate uncinus on each side curving

inwards, and exterior to this a very large oblong laminary plate. Formula 1—1—(1.1.) . 1. (1.1.)—1—1.

3. *Eledone cirrosa* (Lamk.).

Outer Haaf, Shetland (*A. M. N.*), St. Andrews (*McIntosh*!), Firth of Forth (*McBain, Hoyle, &c.*), Lamnish Bay, Arran, N.B. (*Herdman*), Tenby (*C. Jefferys*!), off S.W. Ireland, H.M.S. 'Research,' 1889 (*G. C. Bourne*!), Aberdeen and North Wales (*Hoyle, in litt.*), off the Butt of Lewis in 40 fathoms, 'Triton' exped. (*Hoyle*).

Distribution. Mediterranean, West France, Denmark, Sweden, West Norway, and Faroe Islands.

The males have the arms very long and greatly attenuated and they are not usually coiled up as in the female. Their extremities bear elongated and thin cutaneous lobes transversely placed and closely crowded together; the ends of these project in mature specimens beyond the margin of the arm like so many filaments, while in the centre of each lobe is a pore which represents the rudimentary sucker. In younger males these cutaneous expansions of the suckers are much smaller, and do not extend beyond the sides of the arms. The third right arm is hectocotylized, much shorter than the left, and very deep throughout. Along its lower margin there runs a fleshy lobe, which is curved upwards along the inner side of the arm, so as to form a channel throughout its length, and extending beyond the extremity of the arm (*i. e.* the portion bearing suckers), is there folded back and united to the inner side of the extremity; the termination of the channel is thus at the furthest point.

It is the *Sepia octopodia*, Pennant, *Octopus ventricosus*, Grant, and *Eledone Pennantii*, MacGillivray*.

Order II. DECAPODA.

A. CHONDROPHORA.

Suborder I. OPISTHARSENIA.

Fam. 1. Sepiolidæ.

Genus 1. ROSSIA, Owen.

Body short, subglobose or oblong; anterior margin wholly

* Herr H. J. Posselt has recently (in "Petersen, Del Videnskablige Udbytte af Kanonbaaden 'Hauchs' Togter i de Danske Have inden for Skagen 1883-86" (1889), p. 139) pointed out distinctions between the males of *E. Aldrovandi* (Rafinesque) and of the present species. The differences are very slight, and how are the females to be distinguished? No doubt Herr Posselt represents not only his own views but also those of Professor Steenstrup; and I have in deference to their opinions here kept *E. cirrosa* as distinct from *E. Aldrovandi*.

free and unconnected by membrane dorsally with the head; *fins* more or less ovate, situated nearly centrally on the sides; *arms* rather short, their suckers in two or four rows; *tentacles* with angular or rounded stalks, their apices slightly expanded, with very numerous small suckers; *gladius* small, narrow. *Radula* with seven teeth in each transverse row, teeth unicuspidate, with smooth edges, formula 2—1.1.1—2. *Male* with some of the suckers of second and third arms much larger than usual and more pedunculated; one or both of the first (dorsal) arms more or less hectocotylized.

4. *Rossia macrosoma* (delle Chiaje), Gerv. & van Ben.

Sepiola macrosoma, delle Chiaje, Mem. stor. anim. (1829), pl. lxxi. (*vide* Gerv. and van Ben.).

Sepiola macrosoma, Gerv. et van Ben. Bull. Acad. Sci. Bruxelles, 1839, p. 39, pl. vi.

Rossia macrosoma, d'Orb. Céph. Acét. 1839, p. 245, Sépioles, pl. iv. figs. 13–24.

Rossia Owenii, Ball, Proc. Roy. Irish Acad. ii. (1842), p. 193, ♂.

Rossia Jacobi, id. ibid. p. 193, ♀.

Rossia Owenii, Lovén, Öfvers. k. Vetensk.-Akad. Förhand. 1845, p. 121.

Rossia Owenii, Forbes and Hanley, Hist. Brit. Moll. 1853, iv. p. 223, pl. SSS. fig. 1, ♂.

Rossia macrosoma, iid. ibid. p. 222, pl. MMM. fig. 1.

Rossia macrosoma, Jeffreys, B. C. iv. 1869, p. 133, pl. vi. fig. 1.

Rossia Panceri, Targ.-Tozz. Cep. Mus. Firenze, 1869, p. 46, pl. vii. fig. 7, ♂.

Rossia Oweni, Hoyle, Report 'Challenger' Ceph. 1886, p. 114, pl. xv. figs. 1–9.

In the 'Challenger' Report Mr. Hoyle doubtfully regarded *R. macrosoma* and *R. Oweni* as specifically distinct, and gave five characters in which he then thought they differed. We have now examined together the larger series of specimens in our joint collections, and I have his authority for stating that he no longer regards the first four points as tenable, though he is disposed to consider the fifth, namely that the tentacular suckers (on the margin of the club) are larger in *R. Oweni* than in *R. macrosoma*, as sufficient to separate the species. Now I grant that this seems to hold good when British and Mediterranean examples are actually compared; but the difference of size is very slight and only relates to the suckers near the base of the tentacular club, and I cannot think that such a slight variation is of sufficient importance to retain even a varietal name, much less specific. Some amount of variation must be allowed. Almost any Mediterranean shell can be distinguished by the practised eye from examples of the same species from our own seas; and in many cases if mixed lots of a shell were placed before me collected in the restricted

area of our own seas I could at once pick out with certainty specimens of many forms which I could rightly, by differences of form, sculpture, and colouring, assign to their special habitats.

For description and good figures of the species I would refer to the 'Challenger' Report.

The males are at once known from the females by the outer rows of suckers of the arms, especially of the second and third pair, being much more developed than those of the central rows, while in the females the size of the suckers in all the rows is subequal. The left dorsal arm of the male is also to some extent hectocotylized.

This was formerly regarded as a very rare species on our coast; but the use of the trawl has shown it to be far from uncommon in 40-90 fathoms in the Clyde district and off the west of Scotland. It was also taken in the 'Porcupine' expedition in the Minch and off the coast of Wexford, and by the 'Triton' off the Butt of Lewis in 40 fathoms (*Hoyle*). Other localities are Dublin Bay (*Ball*), Isle of Wight (*Forbes and Hanley*).

Distribution. Kattegat (*Steenstrup*), South Sweden (*Lovén*), South and West Norway (*G. O. Sars*), Mediterranean (*d'Orbigny*), Naples (*Staz. Zool.*!).

Subgenus FRANKLINIA *.

Suckers of the arms in two rows only throughout their length. Besides the species here described the following will fall into this subgenus:—*R. megaptera*, Verrill, and apparently *Heteroteuthis tenera*, Verrill.

5. *Rossia glaucopis*, Lovén.

Rossia glaucopis, Lovén, Kongl. Vet.-Akad. Förh. 1846, p. 135.

Rossia papillifera, Jeffreys, B. C. v. (1869), p. 134.

Rossia glaucopis, G. O. Sars, Moll. Reg. Arct. Norv. 1878, p. 337, pl. xxxii. and pl. xviii. fig. 6.

Rossia glaucopis, Hoyle, Report 'Challenger' Cephalopoda, 1886, p. 116; id. Proc. Roy. Phys. Soc. Edinb. 1886, p. 24.

Two specimens taken by Jeffreys in 60-100 fathoms off the north of Shetland, and a specimen is in my collection which I dredged on the Outer Haaf, Shetland, in 1867.

Professor Steenstrup and Mr. Hoyle have both examined a specimen labelled in Jeffreys's handwriting "*Rossia papillifera*, Shetland," which appears to have been the type of *R. papillifera*, and they have identified it with Lovén's species.

* Named after Capt. Sir John Franklin, the Arctic voyager.

Distribution. A specimen was taken by the 'Porcupine,' 1869, St. 65, lat. $61^{\circ} 10' N.$, long. $2^{\circ} 21' W.$, 345 fath., temp. $30^{\circ} 0$ Fahr.* Finmark (*Lovén*), whole coast of Norway and East and West Finmark, 60–200 fath. (*G. O. Sars*).

The following is Sars's description of this species:—

"Corpus breve et obesum, supine papillis minutis sparsis obsitum, pallio ovato capite vix duplo longiore, margine antico in medio angulum obtusum formante, pinnis semicircularibus longe sejunctis; brachiis robustis, lateralibus inferioribus longioribus dimidium corporis longitudinem superantibus, acetabulis magnis, biseriatis, regularibus; tentaculis corporis longitudinem vix assequentibus, apice breviter dilatato, acetabulis minutis, longe pedunculatis, multiseriatis obsito. Color fusco-rufescens, chromatophoris numerosis minutis. Long., brachiis exclusis, 35 mm. Segmenta radulæ: 40.

6. *Rossia sublevis*, Verrill.

Rossia sublevis, Verrill, Amer. Journ. Sci. xvi. (1878), p. 209, xix. (1880), p. 291, pl. xv. fig. 3; Bull. Mus. Comp. Zool. viii. (1881), p. 104, pl. iii. figs. 2–4, pl. vii. fig. 4; Trans. Connect. Acad. Sci. v. (1881), p. 354, pl. xxx. fig. 2, pl. xxxi. fig. 3, pl. xlv. fig. 4, pl. xlvii. figs. 2–4. *Rossia sublevis*?, Hoyle, Report 'Challenger' Cephalopoda (1886), p. 117.

Mr. E. A. Smith records *Rossia sublevis* (Ann. & Mag. Nat. Hist. ser. 6, iv. (1889), p. 420) as having been taken in 1889 by the 'Flying Fox' in 250 fath. off the south of Ireland.

Distribution. North-east American coast, in 42–372 fath. (*Verrill*), and by the 'Blake' exped., lat. $32^{\circ} 33' N.$, 233–260 fath. (*Agassiz*).

Is this distinct from *R. glaucopsis*? I cannot think so. Verrill's description of *R. sublevis* accurately accords with the characters of the former species. With respect to distinctions he writes:—"This species very closely resembles the *Rossia glaucopsis*, *Lovén*, of Northern Europe, as figured by *G. O. Sars*. The latter is, however, more papillose and has smaller eyes and head, if correctly figured." But with respect to the papillosity Verrill says, "Upper surface of the body and head

* This station is exactly on the line of demarcation of the British area, but from the temperature ought not, I think, to be regarded as British. It is impossible to define a more exact boundary than that I have given at this particular spot (see introductory notes). The next station, 66, at depth 267 fath., has temp. $45^{\circ} 7$ Fahr. Had I gone one half degree further east (*i. e.* $4^{\circ} 30' W.$) for N.E. line of boundary, it would have fallen within the 100-fathom Shetland area in places.

nearly smooth, but in the larger specimens, especially the males, usually with a few whitish papillæ, most numerous near the front edge of the mantle." Now Verrill's largest specimens, which have the mantle 29–31 millim. long, are just the size of that figured by Sars, while my smaller Shetland specimen of *R. glaucopsis*, length of mantle 13 millim., is nearly quite smooth. Again, as regards the form of the head, Verrill's two figures (pl. xxxi. fig. 3, and pl. xlvii. fig. 2) exhibit marked differences in form both of head, body, and of position of fins, as great as between one of those figures and that given by Sars; while my specimen has the eyes quite as prominent as they are represented in the latter figure of Verrill just referred to.

I have not united the species only because it is perhaps desirable that specimens of the two should be examined side by side before that is done.

Genus 2. SEPIOLA (Rondeletius), Leach.

Head dorsally attached to the body by connecting membrane. *Body* short, suboval or oblong. *Fins* latero-dorsal, rounded. *Head* almost as large as the body. *Eyes* prominent, covered by an expansion of the skin. *Tentacular arms* long, retractile, dilated at their extremities. *Arms* subulate, suckers generally two-rowed, but at the extremity sometimes many-rowed. *Males* have one of the first arms (left) hectocotylyzed and the third pair stronger than in female, and curiously forced down from their bases into the cavity of the mouth. *Gladius* lancet-shaped or linear, small, about half the length of the body. *Radula* as in *Rossia*.

7. *Sepiola scandica*, Steenstrup.

Sepiola Rondeletii, Leach, Zool. Miscell. iii. (1817), p. 140 (nec Gesner); Forbes and Hanley, Hist. Brit. Moll. iv. (1853), p. 220 (partim), pl. MMM. fig. 1.

Sepiola scandica, Steenstrup, Notæ "Teuthologicæ, 6," Overs. Danske Vidensk. Selsk. Förh. 1887, p. 65; Giard, Ann. & Mag. Nat. Hist. ser. 6, iv. 1889, p. 182; Posselt, in Petersen, Vidensk. Udbytte af 'Hauchs' Togter, 1889, p. 141.

Fins about equal to and not longer than half the entire length of the mantle. Suckers of all the arms two-rowed to their extremities. Valve of the funnel small in female, absent in male. Ink-bag simple, that is pyriform. Gladius narrow, linear or setiform.

Off Little Cumbræ, Firth of Clyde, 50 fathoms (*A. M. N.*) ; mouth of Loch Fyne, 48 fathoms, and West of Scotland (*Hoyle*).

Mr. Hoyle and myself have examined together the British and Mediterranean specimens of this genus (including *S. Rondeletii* and *S. Petersi* of the Mediterranean) which are in our two collections, and I only give those localities from which we have determined specimens. It must for the present remain in doubt whether the true *S. Rondeletii*, which is characterized by an auriculate or trilobed ink-sac, by fins equalling more than half (about three fifths) of mantle, and by having all the suckers of the arms two-rowed, occurs on our coast. Giard records it from Roscoff.

Distribution. Roscoff (*Giard*), Denmark, Sweden, South and West Norway, and Faroe (*Steenstrup and Posselt*).

8. *Sepiola atlantica*, d'Orbigny.

Sepiola atlantica. d'Orbigny, Céph. Acét. p. 235, Sépioles, pl. iv. figs. 1-12; Forbes and Hanley, Brit. Moll. iv. p. 217, pl. MMM. fig. 2; Steenstrup, Note "Teuthologicæ, 6," Overs. Kongl. Danske Vidensk. Selsk. Förh. 1887, p. 65; Hoyle, Fauna of Liverpool Bay, 1886, p. 279; Giard, Ann. & Mag. Nat. Hist. ser. 6, iv. (1889), p. 182; Posselt, in Petersen, Vidensk. Udbytte af 'Hauchs' Togter, 1889, p. 141.

Fins equal to more than half (about three fifths) the length of the mantle. Suckers of the arms two-rowed, but the fourth (ventral) arms having the suckers near their tips suddenly becoming many-rowed, very minute, and crowded in both sexes. Funnel furnished with a valve, which in the male is very much smaller than in the female. Ink-bag trilobed or auriculate. Gladius lanceolate or cultriform. In the male the suckers of the arms are fewer and larger than in the other sex. One of the first arms is largely developed, swollen, and widened laterally, with a hollow about the middle of its length. The third arms of male in this and other species of the genus are strongly forced down upon the oral opening.

Bantry and Jersey (*A. M. N.*), Plymouth (*Zool. Lab.!*), North Wales (*Hoyle*).

Distribution. Roscoff and Pas de Calais (*Giard*), Kattegat, South Sweden, South and West Norway, and Faroe (*Steenstrup and Posselt*).

Jeffreys united this species with the last as being its male !

Suborder II. PROSTHARSENIA.

Section 1. ANOPROSTHARSENIA.

Tribe I. *OIGOPSIDA*.Fam. 2. **Cranchiidæ.**Genus **TAONIUS**, Steenstrup.9. *Taonius hyperboreus*, Steenstrup.

Leachia hyperborea, Steenstrup, Ann. & Mag. Nat. Hist. ser. 2, xx. (1857), p. 96, note.

Taonius hyperboreus, Steenstrup, Overs. K. D. Vid. Selsk. Forhand. 1861, p. 83.

? *Desmotenthis tenera*, Verrill, Trans. Connect. Acad. Sci. v. (1881), p. 412, pl. lv. fig. 2, pl. lvi. fig. 3.

Leachia ellipsoptera, Carpenter, Jeffreys, and Thomson, 'Porcupine' Report, Proc. Roy. Soc. 1870, p. 423.

Taonius hyperboreus, Hoyle, Report 'Challenger' Ceph. 1886, p. 191, pl. xxxii. fig. 12, and pl. xxxiii. figs. 1-11.

'Porcupine,' 1869. Two specimens at the surface 140 miles north-west of the coast of Ireland, lat. $56^{\circ} 10' N.$, long. $13^{\circ} 16' W.$ (*vide* Hoyle, 'Challenger' Ceph. p. 209).

Distribution. An oceanic species, the known distribution of which is North Greenland (*Steenstrup*), North-east America (*Verrill*), off Halifax, Nova Scotia ('*Challenger*').

Fam. 3. **Onychotenthidæ.**Genus **ONYCHOTEUTHIS**, Lichtenstein, 1818.

Body long, subcylindrical; *fin*s terminal, large, triangular, united dorsally, rhomboidal in their united form. *Eyes* large and prominent. *Arms* having two rows of suckers, which are furnished with horny but not denticulated rings. *Tentacular arms* long and strong, their clubs furnished at the base with a group of suckers, but the greater part of their length armed with two rows of strong grasping hooks. *Radula* very like that of *Loligo*, formula 3—1—3; all the teeth unicuspidate and simple, central and innermost lateral smaller than the others.

Pen with a long pointed dorso-posterior process.

I am not aware that the male of this genus has been described; but in the allied genus *Enoploteuthis* according to Claus hectocotylization takes place in one of the fourth or ventral arms, and the spermatophores are deposited in the ventral branchial cavity of the females.

10. *Onychoteuthis Banksii* (Leach).

Loligo Banksii, Leach, Zool. Miscell. iii. (1817), p. 141.

Onychoteuthis Bergii, Lichtenstein, Naturgesch. Brasiliens, 1818, p. 1592.

Onychia angulata, Lesueur, Journ. Acad. Nat. Sci. Philad. ii. (1821), p. 99, pl. ix. fig. 3, and p. 296, pl. xvii.

Onychoteuthis Banksii, d'Orbigny, Céph. Acét. 1855, p. 386.

Dr. Rose ('Zoologist,' 1853, p. 3864) records the capture of this species at Banff, Scotland. It is a species which was most unlikely to be mistaken, and, moreover, the specimen appears to have been examined by Arthur Adams; so that there can be no doubt that this oceanic species has been brought to our shores as others have been to the opposite continent.

Its distribution is very general in the Atlantic, Indian, and Pacific Oceans. In Northern Europe it has been recorded from South Sweden and Finmark (*Lovén*), Cattegat and Baltic Sea (*Posselt*).

Fam. 4. Ommastrephidæ.

Genus 1. OMMASTREPES, d'Orbigny.

Subgenus 1. OMMASTREPES, d'Orbigny (s. str.)

= *Ommatostrepes*, Steenstrup = *Sthenoteuthis*, Verrill.

Tentacular arms having the lower portion of their clubs furnished with numerous small smooth-rimmed suckers, alternating with tubercular processes (= "fixing cushions," *Hoyle*) for their mutual adhesion. Ordinary suckers of the clubs in four rows. Arms provided with very broad thin marginal membranes. Caudal fin very broad.

Steenstrup separated the genera or subgenera *Illex* and *Todarodes* from *Ommastrephes* of d'Orbigny for certain species included by d'Orbigny in his Mon. Céph. Acét., and retained that author's name, changed in spelling to *Ommatostrepes*, for the remaining species with *O. Bartramii*, d'Orb. (= *O. cylindricus*, d'Orb.), as the type. Now the group thus restricted is the very one for which Verrill had previously proposed the name *Sthenoteuthis*: but both *O. Bartramii* and *O. gigas* belong to this group, and, as these were the only species originally placed in the genus by its author, *Ommastrephes* must by the laws of nomenclature be retained for it. The generic name cannot be applied to species subsequently included by him in the genus to the exclusion of those first embraced. Moreover, *O. Bartramii* had been taken by writers earlier than Verrill as the type. I follow therefore the nomenclature of Steenstrup and of Hoyle, except that I have treated *Illex* and *Todarodes* as subgenera.

11. *Ommastrephes eblance* (Ball).

Loligo eblance, Ball, Proc. Roy. Irish Acad. vol. i. p. 463.

Ommastrephes eblance, Forbes and Hanley, Hist. Brit. Moll. iv. p. 235, pl. SSS. fig. 2; Steenstrup, Ommat. Blæckspr. p. 97.

Body proportionately short; suckers confined to the clubs of the tentacles, minute and four-ranked at their extremities; fins occupying three sevenths of length of body. The arms bear remarkably large pedunculate suckers, two-ranked and set well apart.

These characters from Forbes and Hanley's description do not accord with any other British species. The four-ranked suckers of the tentacular clubs separate it from *O. Coindetii*, and the absence of suckers on the stems of the tentacular arms distinguish it from *O. sagittatus*.

The localities given by Forbes and Hanley are Dublin Bay (*Warren and Ball*) and Belfast (*W. Thompson*).

Subgenus 2. ILLEX, Steenstrup.

Distinguished from *Ommastrephes* (s. str.) by the absence of all simple suckers and tubercles employed for mutual cohesion on the tentacular clubs, and by the suckers of the club being arranged at the extremity in eight rows. The siphonal reception-groove is smooth at its commencement.

12. *Ommastrephes Coindetii* (Vérany).

Loligo Coindetii, Verany, Mem. Accad. Sci. Torino, vol. i. (1837), p. 94, pl. iv.

Ommastrephes sagittatus, d'Orbigny, Céph. Acét. 1839, p. 345, *Ommast.* pl. i. figs. 1-10 (partim); Forbes and Hanley, Hist. Brit. Moll. iv. (1853), p. 231, pl. RRR. fig. 1; Jeffreys, B. C. v. (1869), p. 129.

Loligo Pille (?), Verany, Céph. Méd. (1851), p. 112, pl. xxxvi. figs. *d-g*. *Illex Coindetii*, Steenstrup, Ommat. Blæsp. Overs. D. K. Vid. Selks. Forh. 1880, pp. 82, 90, &c.; Hoyle, Report 'Challenger' Ceph. (1886), p. 34.

Additional localities. Firth of Forth (*Edinburgh Mus.*, fide *Herdman*); Eastbourne (*Roper*).

Distribution. Mediterranean (*d'Orbigny &c.*), Naples (*Zool. Stat. !*), West and South-west France (*Fischer*).

A fine male in my collection from Naples shows that this species has the right ventral arm hectocotylized. This arm has its lower and outer margin, especially on the distal portion of its length, thickened and widened out laterally, so that the extremity is much broader than the corresponding part of the left arm; at about 1 inch from the extremity the suckers entirely cease, and what were the peduncles of the outer row

are transformed into semielliptical vertical plates, which have the faces turned backwards and their summits bent over in that direction; the corresponding peduncles of the inner row are at first in the form of depressed simple tubercles, but quite at the extremity they also become flattened and closely correspond with those of the outer row opposite to them *.

Subgenus 3. *TODARODES*, Steenstrup.

Tentacular arms having their stems furnished with suckers some way down. Tentacular clubs not furnished at their base with simple suckers and fixing-cushions for their mutual adhesion; suckers arranged in only four rows quite to the extremity. Lateral arms not having a membranous crest. Siphonal reception-groove with small longitudinal grooves at the anterior end.

13. *Ommastrephes sagittatus* (Lamarek).

Ommastrephes todarus, Forbes and Hanley, Hist. Brit. Moll. iv. (1853), p. 233, pl. RRR. fig. 2; Jeffreys, B. C. iv. (1869), p. 128.

Todarodes sagittatus, Steenstrup, Ommat. Blæksp. (1880), pp. 82, 90, &c.; Hoyle, Report 'Challenger' Cephalopoda, 1886, p. 34.
(Non *Ommastrephes sagittatus*, d'Orb.)

Shetland (*Pearcey*!), St. Andrews (*M'Intosh*!), Firth of Forth (*Forbes*), Durham coast (*A. M. N.*).

It has a range coextensive with Europe from the Mediterranean to Finmark, Faroe, and Iceland.

The following is G. O. Sars's description of the radula of this species:—"Lamellæ radulæ in series 7 dispositæ, medianæ et laterales tricuspidatæ, cuspidæ centrali majore et longe protracta; uncini interiores basi intus acute producta, exteriores simplices, falciformes; laminæ limbales distinctæ, minimæ, quadrangulares. Formula radulæ 1—2—1 . 1 . 1—2—1." (*Sars*, l. c. pl. xvii. fig. 1.)

* Verrill has described the hectocotylyzation of the nearly allied American species *Ommastrephes (Illex) illecebrosus* (Lesueur). In the ventral arm of that species the suckers, especially of the outer row for some distance from the extremity, have their pedicels larger and longer, with swollen bases; then the suckers themselves gradually become smaller, till they nearly or quite disappear, and then close to the tip they may again become normal. Steenstrup testifies to hectocotylyzation of the same arm in *Todarodes* and *Dosidicus*, and in *Ommastrephes* (restricted).

Genus 2. ARCHITEUTHUS, Steenstrup.

14. *Architeuthis monachus* (Steenstrup), Verrill.

Architeuthis monachus, Steenstrup, Skand. Naturf. Förhand. vii. Möde, 1856, p. 182 (name only).

Architeuthis dux, Harting, Verhandl. k. Akad. Wet. ix. p. 11, pl. i.

Dinoteuthis proboscideus, A. G. More, Zoologist, 1875, p. 4526.

Architeuthis dux, A. G. More, Ann. & Mag. Nat. Hist. ser. 4, vol. xvi. 1875, p. 123.

Architeuthis monachus, Verrill, Ann. & Mag. Nat. Hist. ser. 4, vol. xvi. 1875, p. 268; Trans. Connect. Acad. Sci. v. 1880, p. 238; Amer. Journ. Sci. and Arts, ix. 1875, p. 124, pls. ii., iii., iv. figs. 9-13.

A species of *Architeuthis* has occurred several times on our coasts, and the species is considered by Verrill, who has seen more specimens of this genus than any other naturalist, to be *Architeuthis monachus*, Steenstrup.

"The mutilated carcass of a huge Cephalopod, perhaps belonging to Steenstrup's species (*Architeuthis monachus*), was stranded in 1860 or 1861 between Hillswick and Scalloway, on the west of Shetland. From a communication received by Prof. Allman it appears that the tentacles were 16 feet long, the pedal arms about half that length, and the mantle-sac 7 feet; the mantle was terminated by fins; one of the suckers examined by Prof. Allman was three quarters of an inch in diameter." (*Jeffreys*, Brit. Conch. v. p. 124.)

In the 'Zoologist' for July 1875, p. 4526, Mr. A. G. More called attention to a gigantic Cephalopod which was cast ashore at Dingle, in Kerry, 200 years ago. It was described as 19 feet in total length; the long arms were mutilated, the remaining part being 11 feet long and as thick as a man's arm; the short arms varied from 6 to 8 feet in length and were as thick as a man's leg, and had two rows of large serrated suckers; the proboscis or buccal mass with beak was capable of projection and of the "size of a man's hand," the beak was like an eagle's, but broader. The whole animal is said to have been as large as a large horse. Mr. More named this specimen *Dinoteuthis proboscideus*; but Verrill writes:—"There is no reason to suppose, from the published accounts, that this specimen differed in any way from *Architeuthis dux*."

"On the 26th April, 1875, a very large calamary was met with on the north-west of Boffin Island, Connemara. The crew of a 'curragh' (a boat made like a 'coracle' with wooden ribs covered with tarred canvas) observed to seaward a large floating mass surrounded by gulls. They pulled out to it, believing it to be a wreck, but to their astonishment found it was an enormous cuttle-fish, lying perfectly still, as

if basking on the surface of the water. Paddling up with caution, they lopped off one of its arms. The animal immediately set out to sea, rushing through the water at a tremendous pace. The men gave chase, and after a hard pull in their frail canvas craft came up with it 5 miles out in the open Atlantic and severed another of its arms and head. These portions are now in the Dublin Museum. The shorter arms measure each 8 feet in length and 15 inches round the base; the tentacular arms are said to have been 30 feet long. The body sank." (*Sergeant Thomas Conner*, of the Royal Irish Constabulary, in the 'Zoologist,' June 1875.)

This specimen was described as follows by Mr. A. G. More under the name of *Architeuthis dux*, Steenstrup, in the 'Annals':—

"Tentacles 30 feet long when fresh (14 and 17 feet can still be made up from the pickled pieces). A few distant, small, and nearly sessile suckers occur at long intervals along the inner surface of the peduncle. The club, measuring 2 feet 9 inches in its present shrunken state, is occupied in the centre of the palm by two rows of large stalked suckers nearly 1 inch in diameter, fourteen in each row; an alternating row of fourteen smaller suckers (half an inch in diameter) occupies the margin on each side of the palm; thus there are twenty-eight large one-inch suckers in the middle, and the same number of half-inch suckers along the outer edge. These outer suckers are each armed with a denticulated bony ring of some twenty-eight teeth pointing inwards; and no doubt the large inner suckers were similarly furnished, but their rings had fallen out or had been removed before the specimens were examined. Just beneath where the large suckers end there occurs a cluster of small suckers, two tenths of an inch in diameter; and these are arranged closely in six transverse rows for about 5 inches along the now narrowing wrist of the club; only a few of the uppermost of these are furnished with denticulate rings; the greater number, like the few small suckers of the peduncle, are sustained by rings with an entire or smooth edge. Above the large suckers of the palm the club tapers upwards, and is again clothed with a great number of small and apparently smooth-ringed suckers.

"The short arm is quite spoiled for examination: all the horny rings are gone; and the suckers themselves are scarcely represented. This arm measured 8 feet in length, and 15 inches round the base, when fresh.

"The beak has a strong wide tooth above the middle of the edge of the inner mandible, and a much narrower notch on

the outer mandible, on each side. The head and eyes were unfortunately lost."

Steenstrup states that *Plectoteuthis*, Owen (1881), is the hectocotylyzed arm of a male *Architeuthus*.

Tribe II. *MYOPSIDA* (restricted).

Fam. 5. *Loliginidæ*.

Genus *LOLIGO*, Lamarck.

Hectocotylyzation takes place in this genus on one of the lower or ventral arms, on the basal portion of which the suckers are normal, after which the size of the sucking-disks gradually diminishes, while that of their peduncles increases in length, till ultimately the disks entirely disappear and papillæ alone remain, which give the extremity of the arm a fringed-like appearance when viewed from the side. In certain exotic species only one side of the arm is thus affected; but in the European forms both rows of suckers are similarly aborted.

[*Loligo vulgaris*, Lamarck (but not *L. vulgaris* of British authors).

Anterior part of sides of body and ventral surface spotted; some of the spots often take a ring-like form, but the body is not painted with long dark markings. Tentacular arms having the central rows of suckers large, the lateral very much smaller, so that the diameter of the latter is only half that of the former and their height one third. Disks of central rows of tentacular arms two to three times as large as largest suckers of third arms, their horny rings having only half their circumference finely toothed, whilst the other half is toothless or only bears a group of four or five small blunt teeth (in the northern form, says Steenstrup, these are indeed the only teeth in the horny ring); suckers of lateral rows with high pointed teeth on the upper half, while the lower half is almost toothless.

Mediterranean, Adriatic, Denmark (*Steenstrup*).

This more southern form will probably be found on our coast; but all the specimens which both Mr. Hoyle and myself have examined belong to the next species.]

15. *Loligo Forbesii*, Steenstrup.

Loligo vulgaris, Forbes and Hanley, Brit. Moll. iv. (1853), p. 226, pl. LLL.

Loligo Forbesii, Steenstrup, K. D. Vid. Selks. Skr. ser. 4, iv. (1856), p. 189, pl. i. fig. 2; Ann. & Mag. Nat. Hist. ser. 2, xx. (1857), p. 84.

Loligo magna, Adams, Gen. Rec. Moll. (1858), pl. iv. fig. 3.

Loligo vulgaris, Jeffreys, B. C. v. (1869), p. 130, pl. v. fig. 2.

Loligo Forbesii, Lenz, Jahresh. Comm. Kiel, Jahrb. i. (1871), p. 135;

Hoyle, Proc. Phys. Soc. Edinb. viii. (1855), p. 459.

Anterior part of sides of body and ventral surface painted with long dark markings. Tentacular arms having the suckers of the central rows scarcely exceeding in size those of the lateral rows either in diameter or height, so that the club looks as if it bore four series of subequal suckers. The disks of the central rows of the tentacular arms are scarcely one third larger than those of the central rows of the third arms; their horny rings bear numerous pointed teeth all round, usually larger and smaller alternately; suckers of lateral rows completely set with teeth of equal size. Length of ordinary specimens 2 feet.

St. Andrews (*M'Intosh*!), Plymouth (*A. M. N.*), Durham and Northumberland coasts (*J. Alder*!); a pen from the Northumberland coast in the Newcastle Museum measures 22 inches in length. Firth of Forth (*Hoyle*).

Jeffreys reunited Steenstrup's species with *L. vulgaris* on the ground that the differences might be sexual, quite overlooking the fact that Steenstrup expressly states, respecting Danish examples, "Of both species I have only been able to examine the males on our coast."

16. *Loligo marmoræ*, Verany.

Loligo marmoræ, Verany, Céph. Médit. 1851, p. 95, pl. xxxvii.; Forbes and Hanley, Hist. Brit. Moll. iv. (1853), p. 230, pl. QQQ. fig. 2.

Off Youghal (*Dr. Ball*, fide *F. & H.*). I have not seen any British specimens of this species.

Mediterranean examples are in my collection from Naples (*Staz. Zool.*) and Nice (*Gal.*).

A mere glance at once distinguishes the form from that of the next species, for while the latter exhibits variation in the proportion of parts of the body, still the body as a whole, as far as I have seen, never assumes the appearance of *L. marmoræ*, which is distinguished by the much broader fins, generally situated further back, and which, reaching quite to the extremity, give an altogether different look to the animal from that of *L. media*. The following are measurements of four specimens:—

	Total length of mantle on the back. millim.	Length from front margin of fin to the extremity of body. millim.	Greatest breadth of fin. millim.
Naples, ♀	69	35	25
" " "	60	30	25
Nice, ♀	105	66	46
" "	93	55	41

The difference between this and *L. media* is certainly not sexual.

17. *Loligo media* (Linné).

Loligo subulata, Lamarec, Mém. Soc. Hist. Nat. Paris (1799), vol. i. p. 15.

Loligo spiralis, Férussac, Dict. Class. Hist. Nat. iii. (1853), p. 67, no. 6.

Loligo parva, d'Orbigny, Céph. Acét. 1848, p. 130, Calmars, pls. xvii. and xxiii. figs. 19-21.

Loligo media, Forbes and Hanley, Brit. Moll. iv. 1853, p. 228, pl. QQQ. fig. 1; Hoyle, Fauna of Liverpool Bay, 1886, p. 279.

I give the following measurements for comparison with those of the preceding species. The first specimen is a male remarkable for its extremely produced form.

	Total dorsal length of mantle. millim.	Length from front margin of fin to extremity of body. millim.	Greatest breadth of fin. millim.
1. Plymouth, ♂ ..	112	77	28
2. " " ♀ ..	85	49	30
3. " " " ..	83	49	30
4. " " " ..	83	53	27
5. " " " ..	74	41	28
6. " " " ..	73	42	26
7. Tenby, ♀	82	52	30
8. " " "	79	47	28
9. " " "	81	52	26
10. Jersey, ♀	76	47	29
11. " " "	63	36	21

These measurements of the two species will show that there is great variation in proportion of parts in each, but that at the same time first that in *L. marmoræ* the portion of the body behind the commencement of the fin is less in proportion to the total length, and secondly that the breadth of the fin is greater in proportion to the distance between its commencement and the termination of the body, so that the triangle thus formed is much less produced. Moreover in *L. marmoræ* the fin is continued to the extremity, whereas in *L. media* it runs out at some distance from it; in specimen 1 of that species (a male remarkably elongated) it disappears at 45 millim. from the much-produced extremity.

The left ventral arm of the male is hectocotylyzed as described under the genus; but in this species a further modification takes place in the fact that the normal suckers at the base of the arm are smaller in size than the corresponding suckers of the right ventral arm.

Specimens in my collection are from Jersey (*Sinel*), Tenby (*C. Jeffery*), Plymouth (*Biol. Lab.*). I have also found it in Lamlash Bay, Firth of Clyde. North Wales (*Hoyle*). It has been found in many other places on our southern coasts, but it becomes scarce northwards.

Distribution. In consequence of this species being so frequently confounded with the preceding I hesitate to quote records of its occurrence. It is not without much doubt that I have kept them distinct; but judging from the specimens I here record they appear to be so.

B. SEPIOPHORA.

Section 2. KATOPROSTHARSENIA.

Fam. 6. Sepiidae.

Genus SEPIA, Linné.

18. *Sepia officinalis*, Linn.

The distribution of this species is West Africa, Mediterranean, Spain, France, British Islands (chiefly southern coasts), Sweden (Norway?) *.

Hectocotylyzation takes place in *Sepia* on the lower portion of the fourth or ventral arm. In *S. vulgaris* it is the left arm which is thus affected. It is widened out near the base, only two or three suckers in each row are at the origin of the arm normally developed, whilst the seven or eight following suckers in each row become very small or almost evanescent; the arm, widened much at this part, has the muscles developed in a peculiar manner, "becoming elevated, lying like oblique beams across the arm, and partially crossing amongst themselves, by which means a number of pits are formed, which are especially deep towards the upper margin. Lastly, in these pits and on the portions which separate them the skin is everywhere folded into elevated, thin, membranous laminae, which run together into a reticulated form and give the whole surface of this part of the arm a certain resemblance to the inside of a calf's stomach." (*Steenstrup*.)

* Fischer makes the Mediterranean form a distinct species from the northern, and names it *S. Filionii* (see Journ. Conch. xviii., xx., xxi., xxii.). If that be so, the more southern localities here quoted probably belong to that species.

The radula has seven teeth in each transverse row ; all the teeth are simple and of nearly equal size, except the outer laterals, which are longer.

The eggs are ovoid, with a mamillary distal extremity, and narrowed at their base into a stalk, with which the seaweed to which they are attached is grasped.

Besides the hectocotylization of the arm in the male, the cuttle-bone is smaller and less hollowed than in the other sex.

19. *Sepia rupellaria*, d'Orb.

Sepia rupellaria, d'Orb. & Férussac, Céph. Acét. (1839), p. 275, pl. iii. figs. 10-13.

Sepia biserialis, Verany, Céph. Médit. (1851), p. 73, pl. xxvi. figs. F, K ; Forbes and Hanley, Hist. Brit. Moll. iv. (1853), p. 241, pl. PPP. fig. 2 ; Jeffreys, B. C. v. (1869), p. 141.

Magilligan, north of Ireland (*Hyndman*), Northumberland coast (*Alder*, the specimen now in the Newcastle Museum), Polperro (*Loughrin*), Oxwich Bay, Swansea (*Jeffreys*).

Distribution. Naples (*Zool. Stat.!*), Nice (*Gal.!*), Noirmoutiers and La Rochelle (*d'Orbigny*).

20. *Sepia elegans*, d'Orbigny.

Sepia elegans, d'Orbigny, Seiches (1826), pl. viii. figs. 1-5 : d'Orbigny & Férussac, Céph. Acét. 1839, p. 275, Seiches, pl. viii. figs. 1-5, pl. xxvii. figs. 3-6 ; Jeffreys, B. C. iv. 1869, p. 140.

Jersey (*A. M. N.*), Polperro, Cornwall (*J. Couch*, in *Alder's* Coll. in Newcastle Museum), Guernsey (*Lukis*), Oxwich Bay, near Swansea (*Jeffreys*).

Distribution. Messina, Adriatic, coast of Algiers, and Malaga (*d'Orbigny*), Naples (*Zool. Stat.!*), Nice (*Gal.!*).

[C. PHRAGMOPHORA.

Shell in the form of a series of air-cells, connected with each other by means of a siphon.

Fam. 7. Spirulidæ.

Genus SPIRULA, Lamarck.

Spirula Peronii, Lamarck.

Spirula Peronii, Forbes and Hanley, Hist. Brit. Moll. iv. (1853), p. 242.

Dead shells occasionally washed to the western shores of Great Britain as well as of the rest of Europe, but never taken alive so far north.]

[To be continued.]